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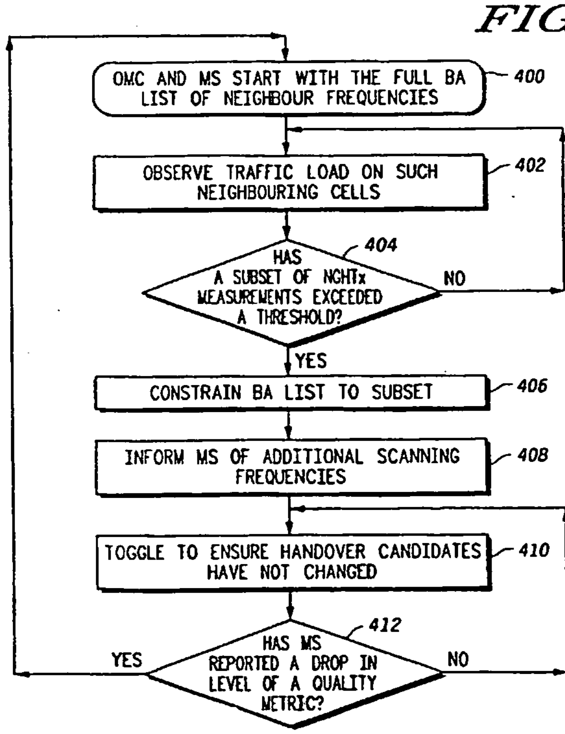
(54) Abstract Title
Scanning communication resources for resource planning

(57) A mobile station scans communication resources of adjacent cells for communication resource planning if it is determined that signal quality measurements of a first subset of resources exceed a threshold. The first subset may be the minimum BTS Allocation (BA) list required for handover purposes. If the quality measurements of the BA list exceed a threshold, the list may be augmented with frequencies to be scanned to assist in automatic frequency planning.

FIG.4



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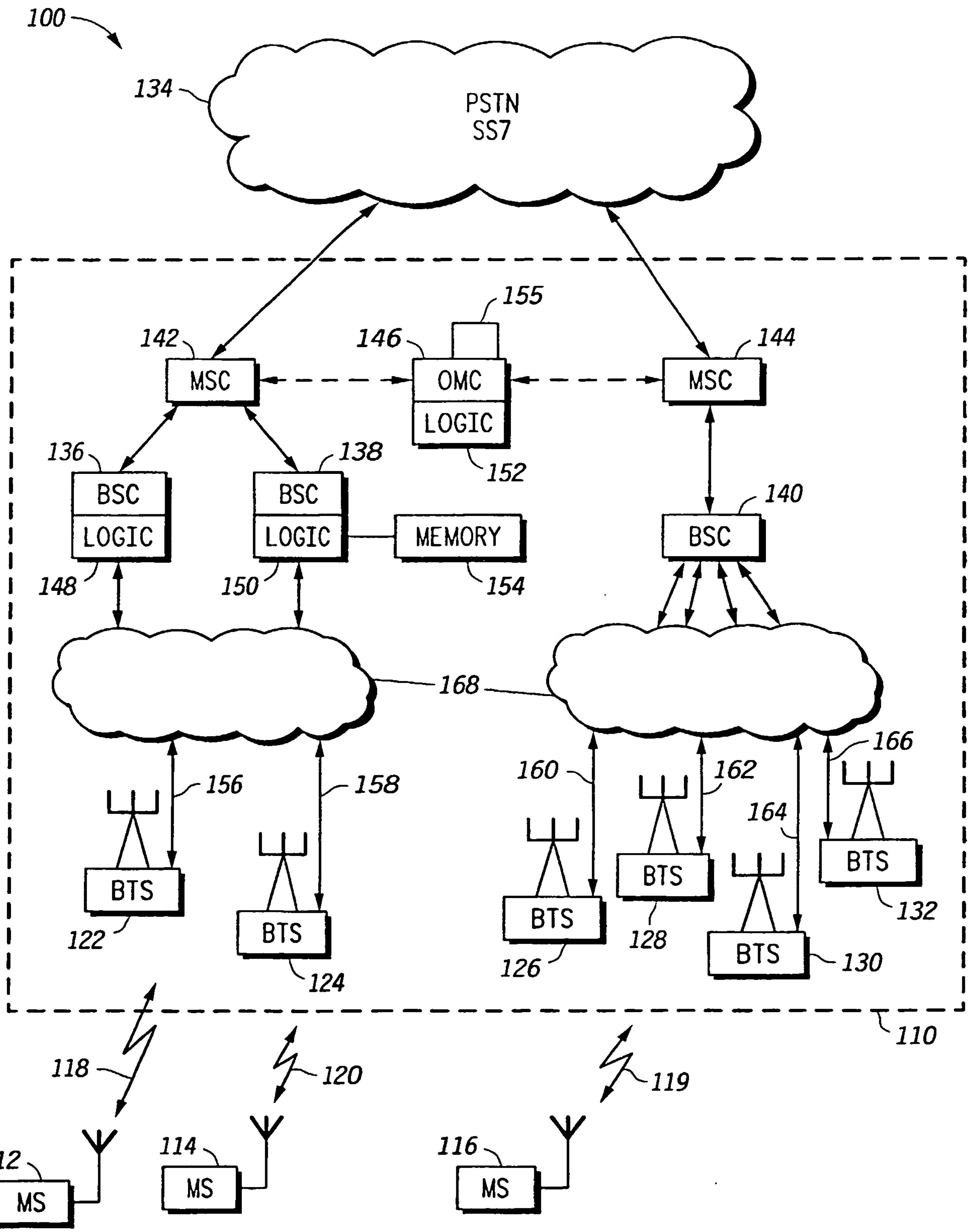
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.


100
134
PSTN
SS7
142
MSC
146
155
OMC
LOGIC
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144
MSC
136
BSC
LOGIC
148
138
BSC
LOGIC
150
MEMORY
154
140
BSC
168
156
158
160
162
164
166
BTS
122
BTS
124
BTS
126
BTS
128
BTS
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BTS
132
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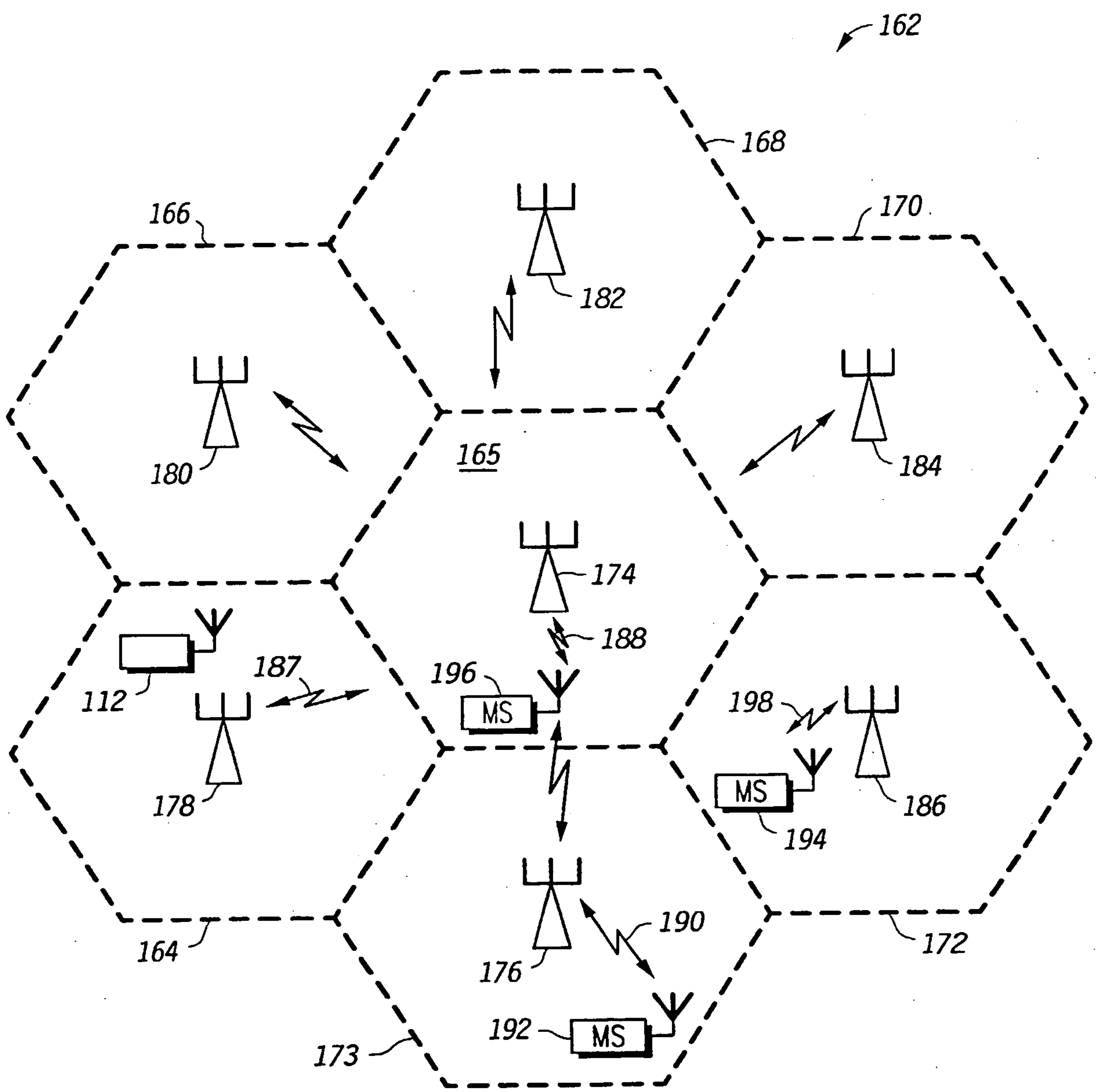
118
120
119
112
MS
114
MS
116
MS

FIG.1


162
168
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165
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192
MS
173

FIG.2

FIG.3

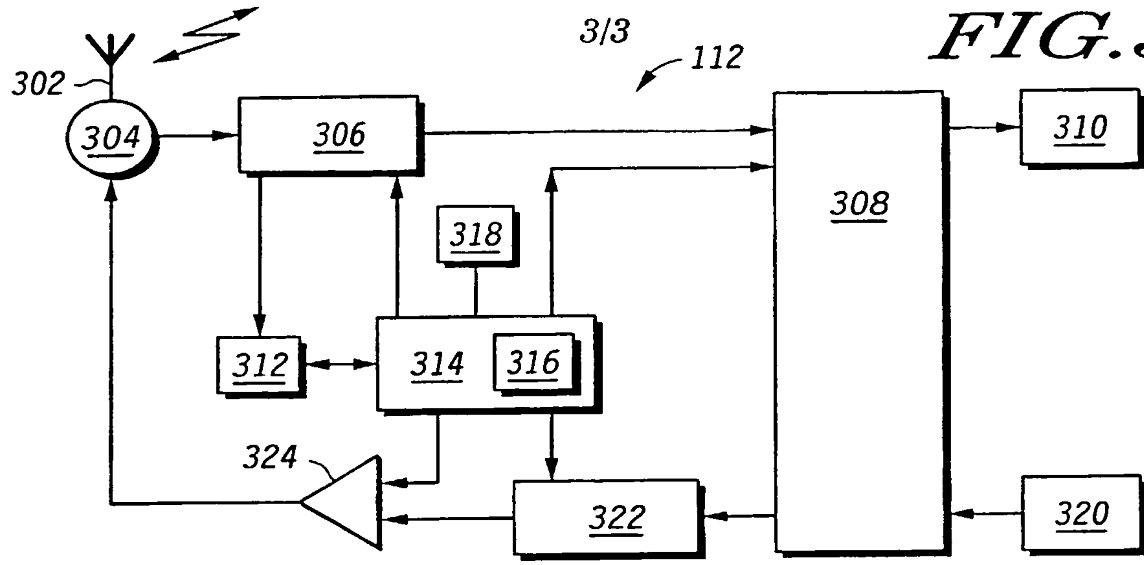
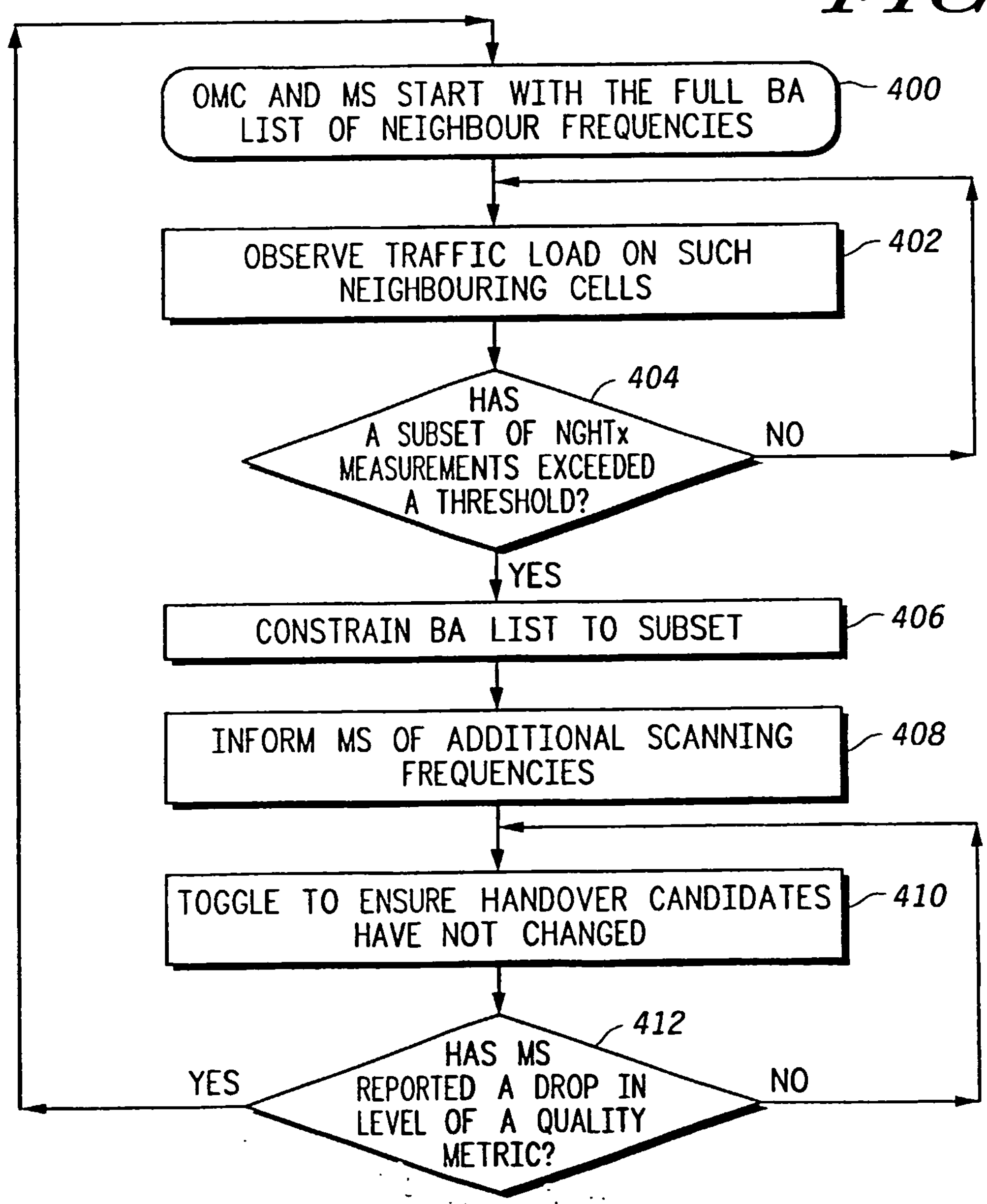

302
304
306
112
308
310
318
312
314
316
324
322
320

FIG.4


OMC AND MS START WITH THE FULL BA LIST OF NEIGHBOUR FREQUENCIES
400
OBSERVE TRAFFIC LOAD ON SUCH NEIGHBOURING CELLS
402
HAS A SUBSET OF NGHTx MEASUREMENTS EXCEEDED A THRESHOLD?
404
NO
YES
CONSTRAIN BA LIST TO SUBSET
406
INFORM MS OF ADDITIONAL SCANNING FREQUENCIES
408
TOGGLE TO ENSURE HANDOVER CANDIDATES HAVE NOT CHANGED
410
HAS MS REPORTED A DROP IN LEVEL OF A QUALITY METRIC?
412
YES
NO

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COMMUNICATION SYSTEM, COMMUNICATION UNIT, AND METHOD FOR SCANNING ADJACENT CELLS IN A COMMUNICATION SYSTEM

Field of the Invention

This invention relates to frequency planning in a wireless communication system. The invention is applicable to, but not limited to, utilising information obtained from a mobile scanning operation in order to assist automatic frequency planning.

Background of the Invention

Wireless communication systems, for example cellular telephony or private mobile radio communication systems, typically provide for radio telecommunication links to be arranged between a plurality of base transceiver stations (BTSs) and a plurality of subscriber units, often termed mobile stations (MSs).

In a wireless communication system, each BTS has associated with it a particular geographical coverage area (or cell). The coverage area is defined by a particular range where the BTS can maintain acceptable communications with MSs operating within its serving cell. Often these cells combine to produce an extensive coverage area.

Wireless communication systems are distinguished over fixed communication systems, such as the public switched telephone network (PSTN), principally in that mobile stations move between coverage areas served by different BTS (and/or different service providers) and, in doing so, encounter varying radio propagation environments.

In such wireless communication systems, methods for communicating information simultaneously exist where communication resources in a communication network are shared by a number of users. Such methods are termed multiple access techniques. A number of multiple access techniques exist, whereby a finite communication resource is divided into any number of physical parameters, such as:

(i) frequency division multiple access (FDMA) whereby frequencies used in the communication system are shared,

(ii) time division multiple access (TDMA) whereby each frequency used in the communication system, is shared amongst users by dividing the communication resource (each frequency) into a number of distinct time periods (time-slots, frames, etc.), and

(iii) code division multiple access (CDMA) whereby communication is performed by using all of the respective frequencies, in all of the time periods, and the resource is shared by allocating each communication a particular

code, to differentiate desired signals from undesired signals.

Within such multiple access techniques, different duplex (two-way communication) paths are arranged. Such paths can be arranged in a frequency division duplex (FDD) configuration, whereby a frequency is dedicated for up-link communication and a second frequency is dedicated for down-link communication. Alternatively, the paths can be arranged in a time division duplex (TDD) configuration, whereby a first time period is dedicated for up-link communication and a second time period is dedicated for down-link communication.

Furthermore, in a wireless communication system, it is known that MSs scan signal transmissions from multiple BTS to determine optimal handover candidates, namely the BTS offering the highest quality signal/communication link to the respective MS. Often, a fixed scan list (i.e. a list of frequencies) is proposed to mobile stations (MSs) for scanning purposes, to determine optimal handover candidates.

As a consequence of the fixed scan list being focused on the better handover candidates a MS does not report on weaker frequencies. The inventor of the present invention has recognised that it is beneficial for these weaker frequency signals to be reported to alleviate interference problems on subsequent frequency re-plans. Without the capability to report weak signals an automatic frequency planning system will need to be

reliant on external network information.

Automatic frequency planning is arguably the most challenging and time consuming task in designing a mobile communication network. Effective usage of the frequency spectrum, one of the scarcest resources for any operator, leads to both better communication network quality and increased capacity.

Automating a frequency planning process typically produces higher quality frequency plans and yields a multitude of benefits, such as:

(i) a higher quality of service may be achieved in networks with minimal opportunity for frequency reuse;

(ii) a major capital expenditure in infrastructure may be deferred, as the current network is able to handle more traffic at a given quality of service; and

(iii) the time for frequency planning is reduced - enabling system designers the time to concentrate on other, more complex enhancements to network quality.

In particular, automatic frequency planning (AFP) is a useful feature in the planned widespread deployment of in-building pico-cellular systems. To ensure seamless connectivity between pico-cells, handover functionality

must be maintained.

A key component of handover operation is maintaining an optimal BTS allocation (BA) list, held by each pico-cell, to ensure that mobiles are scanning the better handover candidate cell frequencies. For systems supporting AFP application there is a requirement on active MSs to scan as many frequencies as possible to aid frequency planning. This information is fed into an AFP application that can determine the optimal frequency plan for the communication system.

Such contrasting reasons for scanning have so far resulted in scanning operations being primarily focused on handover opportunities. However, the inventor of the present invention has recognised the benefits in balancing the conflicting procedures of handover and frequency scanning in the generation of a dynamic BA list.

Thus there exists a need in the field of the present invention to provide a communication system, a communication unit, and method for obtaining information from a mobile scanning operation to simultaneously assist for automatic frequency planning whilst maintaining handover capability, wherein the aforementioned disadvantages may be alleviated.

Statement of Invention

In accordance with a first aspect of the present invention there is provided a method for scanning adjacent cells in a wireless communication system, as claimed in claim 1.

In accordance with a second aspect of the present invention there is provided a communication system, as claimed in claim 14.

In accordance with a third aspect of the present invention there is provided a communication unit, as claimed in claim 15.

In accordance with a fourth aspect of the present invention there is provided a storage medium, as claimed in claim 16.

In accordance with a fifth aspect of the present invention there is provided a communication system, as claimed in claim 17.

In accordance with a sixth aspect of the present invention there is provided a communication unit, as claimed in claim 26.

Brief Description of the Drawings

Exemplary embodiments of the present invention will now

be described, with reference to the accompanying drawings, in which:

FIG. 1 shows a block diagram of a cellular radio communications system adapted to support the various inventive concepts of a preferred embodiment of the present invention.

FIG. 2 shows a cell-based communication system adapted to support the various inventive concepts of a preferred embodiment of the present invention.

FIG. 3 shows a block diagram of a subscriber unit adapted to support the inventive concepts of the preferred embodiments of the present invention.

FIG. 4 shows a flowchart of a method of scanning adjacent cells in accordance with a preferred embodiment of the present invention.

Description of Preferred Embodiments

In summary, the inventive concepts of the present invention alleviate the problems associated with prior art arrangements by utilizing a dynamic observation of the traffic load in say, a pico-cell environment and determining a minimum BTS Allocation (BA) list required for handover purposes. In accordance with the preferred embodiment of the invention, the BA list is then

augmented with frequencies to be scanned to assist in automatic frequency planning in the communication system.

In accordance with a preferred embodiment of the invention, signal quality measurements are made from neighbouring MS(s), and are reported to its serving BTS. Subsequently, the information is used to assist in an automatic frequency planning system.

Referring first to FIG. 1, a cellular telephone communication system 100 is shown, in outline, supporting a Global System for Mobile communication (GSM) air-interface, in accordance with a preferred embodiment of the invention. The GSM air-interface has been defined by the European Telecommunications Standards Institute (ETSI).

Generally, the air-interface protocol is administered from base transceiver sites, within the network architecture 110, that are geographically spaced apart - one base site supporting a cell (or, for example, sectors of a cell), as shown in FIG. 2. Similarly, co-located base transceiver sites supporting, say, both pico- and micro- cellular communications may also benefit from the inventive concepts described herein.

A plurality of subscriber units 112-116 communicate over the selected air-interface 118-120 with a plurality of base transceiver stations (BTS) 122-132. A limited number of MSs 112-116 and BTSs 122-132 are shown for

clarity purposes only. The BTSs 122-132 may be connected to a conventional public-switched telephone network (PSTN) 134 through base station controllers (BSCs) 136-140 and mobile switching centres (MSCs) 142-144.

Each BTS 122-132 is principally designed to serve its primary cell, with each BTS 122-132 containing one or more transceiver units and communicating 156-166 with the rest of the cellular system infrastructure

Each Base Station Controller (BSC) 136-140 may control one or more BTSs 122-132, with BSCs 136-140 generally interconnected through MSCs 142-144. Processes within the MSCs are provided to account for the situation where a MS (112-116) passes between two BTS serving areas, for example MS 112 moving from an area covered by BTS 122 to an area covered by BTS 124, where the two BTSs are controlled by different BSCs (BSC 136 and BSC 138 in this example).

Similar processes are supported in MSCs to account for the situation where an MS moves between serving BTSs where these BTSs are connected to different MSCs. These mechanisms therefore allow the cellular telephone communication system to support handover of MSs 112-116 between cells for most, if not all, cases encountered.

Each MSC 142-144 provides a gateway to the PSTN 134, with MSCs 142-144 interconnected through an operations and management centre (OMC) 146 that administers general

control of the cellular telephone communication system 100, as will be understood by those skilled in the art.

The various system elements, such as BSCs 136-138 and OMC 146, will include control logic 148, 150, 152, with the various system elements usually having an associated memory function 154 (shown only in relation to BSC 138 for the sake of clarity). A memory function of the OMC 146 typically stores historically compiled operational data as well as in-call data, system information such as neighbouring cell-site lists (i.e. the BA list 155) and control algorithms such as a list of frequencies to be scanned by the respective MSs.

The cellular communication system 100 is preferably a pico-cell sized communication system, as known to those skilled in the art, providing cellular telephony communication to in-building environments. However, it is within the contemplation of the invention that the inventive concepts described herein apply equally to higher-layer cell-based communication systems such as micro-cell and macro-cell systems.

Table 1: below shows how the BA list 155 incorporating list of non-handover-related scanning frequencies has been adapted in accordance with a preferred embodiment of the present invention.

Table 1:

Channel frequencies over entire Broadcast band	Original BA List	Top 3*	New BA List
f_1	✓		
f_2	×		✓
f_3	✓	✓	✓
f_4	✓		
f_5	×		✓
f_6	✓	✓	✓
f_7	×		
f_8	✓		
f_9	×		✓
f_{10}	×		
f_{11}	×		
f_{12}	×		
f_{13}	✓	✓	✓
f_N			

Table 1 depicts an example modification of an original BA list to enable other frequencies to be monitored. The BA list is trimmed down to preferably a 'top 3' candidate frequencies, so that alternative scanning frequencies can be used in the new BA list. It is within the inventive concept of the present invention that the top 3 can be chosen based on any number of parameters, for example signal strength, number of reports, quality etc.

In accordance with a preferred embodiment of the present invention, the BA list and list of non-handover-related scanning frequencies are linked such that the differing requirements of handover and a general knowledge of the signal potential of selected neighbouring cells are balanced.

Consequently, the respective MSCs 142, 144 have also been adapted, to use the information provided in organising the traffic management within their respective sites.

It is within the contemplation of the invention that the modified BA list and/or list of non-handover-related scanning frequencies may be managed within any other element within the infrastructure, such as MSCs 142, 144, or within BSCs 136, 138, 140 or distributed within a number of elements, if appropriate.

It is also within the contemplation of the invention that alternative radio communication architectures, such as private or public mobile radio communication systems could benefit from the inventive concepts described herein.

Turning now to FIG. 2, a conventional cell plan 162 containing interconnected cell areas 164-173 is shown. Each cell area has a base station sub-system (BSS) 174-187 with MSs 192-197 respectively affiliated therewith, shown via communication links 188, 190.

Generally, as will be understood by persons skilled in the art, a MS is in communication with its nearest BTS (which together with the BSC forms the BSS); one example of this relationship is shown in relation to BSS 174 and mobile station 114 of cell 165.

MS 112 is shown having chosen cell 164 as the cell it currently is associated with, namely the cell that the MS has 'camped on'. This cell selection is usually based on signal strength and/or signal quality indications determined by monitoring broadcast channel transmissions sent from the BSS of each cell, in this case BSS 178.

Once camped on cell 164, MS 112 will transmit a location update message to the BSS 178 of that particular cell 164, when triggered by a timer, which is set by the network operator. In that way, all MS must periodically report their position in order to optimise mobile position and maintain mobile battery power. BSS 178 of the cell 164 reports this location information back into the network to its attached MSC, and thereto the OMC.

In accordance with the preferred embodiment of the invention, MS 112 will likely be scanning adjacent cells 166, 165 and 173, as part of the original BA list 155.

However, the serving BTS 178 transmits information 197 to MS 112. The information recommends that MS 112 to monitor a predefined list of located NeiGHbouring Transceivers (NghTx) 174, 180, 190 from the original BA list 155. Assuming that the received signal quality of

signals received from these three sites is above a threshold, the information 197 transmitted by the BTS 178 may include details of other frequencies, time-slots (TS) and/or spreading codes (if it is a CDMA system) used by these NeiGHbouring Transceivers 182-186. Initially, these details may already known by the serving BTS 178, as they were used in setting up the NghTx list.

It is within the contemplation of the invention that MS 112 may report information relating to its dedicated NghTx list in whole or in part. In accordance with the preferred embodiment of the invention, an adapted NghTx list may be sent to MS 112 on a selected down-link channel, for example a Dedicated Channel (DCH).

Once the adapted NghTx list is received at the MS 112, MS 112 begins to scan the respective time-slot(s) of selected MS using the information specified in the NghTx list. When MS 112 has synchronised on a given slot and code, it measures any number of parameters related to the decoded signal such as timing, received signal strength (RSS), etc.

Once all of the frequencies and/or time slots specified in the NghTx have been scanned, MS 112 reports the measurements to BTS 178, which in turn reports the measurements to its MSC and thereon to the OMC 146. These measurements are preferably reported on the paired up-link channel to the down-link channel used initially by BTS 178 to transmit the NghTx list.

The OMC 146, after assessing such traffic information from one or more MS relating to a number of reported neighbouring cells can then determine, if appropriate, suitable subsets of BA lists for the respective MS(s) to use. If the signal quality level of a number of reported neighbouring cells, for a particular MS, exceeds a threshold, then OMC 146 assumes that handover capability can be maintained with a subset of such frequencies. Consequently, in accordance with the preferred embodiment of the invention, the OMC 146 recommends that additional scanning frequencies can be used by the MS to assist with the system's automatic frequency planning.

In operation, the OMC 146 is in a position to exploit the variable load and mobility of the traffic between cell sites to increase the value to the communication system of frequencies that can be scanned. Changing the BA list within a call presents no problems to current GSM equipment. In addition, the increased C/I requirements of GSM data solutions, such as the general packet-data radio system (GPRS) and enhanced data rate for global evolution (EDGE) which encompasses enhanced GPRS (EGPRS), will substantially benefit from such detection and reporting of weak signals.

Indeed, any cellular radio system that adopts frequency segregation as part of the air-interface will benefit from the inventive concepts of the present invention. This invention will permit the optimum selection of frequencies thereby enabling a higher carrier to

interference radio signal ratio that is required for high throughput data services.

More generally, the dynamic adaptation of the BA list and scanning frequencies, programmed according to the preferred embodiment of the present invention, may be implemented in a respective communication unit in any suitable manner. For example, new apparatus may be added to a conventional communication unit (for example OMC 146), or alternatively existing parts of a conventional communication unit may be adapted, for example by reprogramming one or more processors therein. As such the required adaptation may be implemented in the form of processor-implementable instructions stored on a storage medium, such as a floppy disk, hard disk, PROM, RAM or any combination of these or other storage multimedia.

Referring now to FIG. 3, a block diagram of a wireless communication unit is shown, in accordance with a preferred embodiment of the invention. Although the communication unit is described with regard to a mobile station, substantially the same elements and inter-working between such elements is replicated in the wireless serving communication unit (BTS), as known to those skilled in the art. The MS 112 contains an antenna 302 preferably coupled to a duplex filter or circulator 304 that provides isolation between receive and transmit chains within the MS 112.

The receiver chain, as known in the art, includes scanning receiver front-end circuitry 806 (effectively providing reception, filtering and intermediate or base-band frequency conversion). The scanning front-end circuit is serially coupled to a signal processing function 308. An output from the signal processing function is provided to a suitable output device 310, such as a screen or flat panel display.

In accordance with a preferred embodiment of the invention, the scanning front-end circuit searches for transmissions of the neighbouring transceivers (NghTx), as instructed on the BA list or modified BA list.

The receiver chain also includes received signal strength indicator (RSSI) circuitry 312, which in turn is coupled to a controller 814 for maintaining overall subscriber unit control. Measurements of signals from neighbouring cells are made by the RSSI circuitry 312 are stored and later-transmitted to the serving communication unit, to be used in the traffic loading assessment and BA list modification process. The controller 314 is also coupled to the scanning receiver front-end circuitry 306 and the signal processing function 308 (generally realised by a DSP).

The controller 314 may therefore receive bit error rate (BER) or frame error rate (FER) data from recovered information. The controller is also coupled to a memory device 316 that selectively stores operating regimes, such as decoding/encoding functions, synchronisation

patterns, code sequences, RSSI data, direction of arrival of a received signal and the like.

In accordance with the preferred embodiment of the invention, the memory device 316 stores data relating to neighbouring transceivers and/or scanning frequencies. Furthermore, a timer 318 is operably coupled to the controller 314 to control the timing of operations (transmission or reception of time-dependent signals) within the MS 112, particularly with regard to compressed absolute or relative timing parameters of the received signal(s).

As regards the transmit chain, this essentially includes an input device 320, such as a keypad, coupled in series through transmitter/modulation circuitry 322 and a power amplifier 324 to the antenna 302. The transmitter/ modulation circuitry 322 and the power amplifier 324 are operationally responsive to the controller, and as such are used in transmitting the details of the monitored signals and scanned frequencies indicated on the BA list or modified BA list.

The signal processor function 208 in the transmit chain may be implemented as distinct from the processor in the receive chain. Alternatively, a single processor 308 may be used to implement processing of both transmit and receive signals, as shown in FIG. 3. Clearly, the various components within the MS 112 can be realised in discrete or integrated component form, with an ultimate structure therefore being merely an arbitrary selection.

In accordance with the preferred embodiment of the invention, scanning receiver front-end circuitry 306, the transmitter/modulation circuitry 322 and power amplifier 324, under the control and guidance of the signal processing function 308, memory device 316, timer function 318 and controller 314 have been adapted to operate in accordance with a preferred embodiment of the invention.

MS 112 is informed of/requested to monitor a predefined BA list and/or modified BA list. MS 112 is able to switch between such scanning frequencies by adjusting its radio frequency of operation using the scanning receiver front-end circuitry 306, under control of the controller 314.

Such measurements are then transmitted to the serving BTS using transmitter/modulation circuitry 322 and power amplifier 324, under the control and guidance of the signal processing function 308, memory device 316, timer function 318 and controller 314.

It should be noted that there are at least two opportunities for transmitting such signal quality measurements from MS(s):

(i) after each signal quality measurement has been made, thereby improving the real-time accuracy of the traffic load determination process within the OMC 146; or

(ii) as a grouped batch of information, once all of the measurements have been made, thereby minimising the amount of signalling resource used in the process.

The inventive concepts of the present invention utilise dynamic monitoring, by a MS in one cell, of the traffic load in adjacent cells, for example adjacent pico-cells, in order to determine a minimum BA list required for the respective serving cell. Such information, when obtained extensively throughout the system, can be determined and assessed to better plan and utilise available communication resources (frequencies) throughout the system.

In order to achieve such improved frequency planning, the original BA list is intelligently managed, and reduced if appropriate, such that it can be augmented with additional frequencies to be scanned. The additional frequencies to be scanned are selected by the OMC 146 in accordance with the needs of the AFP.

The inventive concepts of the present invention may best be appreciated when viewed with regard to the procedure shown in the flowchart of FIG. 4.

The process starts with the OMC 146 and MS 112 communicating adjacent cell information based on the normal full BA list, with say six or more neighbours, as shown in step 400. Traffic load from the respective

neighbouring cells is observed and reported back to the OMC 146, as in step 402.

If the report(s) indicates a subset of the full BA list of neighbouring cell transmissions can be received above a certain threshold, in step 404, then the OMC constrains the BA list for monitoring by (at least) the respective MS to a subset of the BA list.

It is within the contemplation of the invention that the OMC 146 may use additional indicia, such as traffic load, time of day, etc. to enhance the assessment of communications within the communication system. The OMC 146 instructs the MS 112 to include additional scanning frequencies in its scanning operation, as shown in step 406-408. If the threshold is not exceeded, the process of monitoring the BA list 155 continues, as shown.

It is within the contemplation of the invention that a communication resource selected for the modified BA list may include signal transmissions of any communication resource falls that has fallen below the threshold. Such an approach to intelligently selecting any resources to be scanned can therefore be used to say, fault-check the operation of particular BTS within the network.

Due to the transient nature of mobile communications, the MS may decide for itself, or be instructed by the OMC 146, to toggle back and forth between the original BA list and the modified BA list, to ensure handover candidates, and the opportunity for optimal handover,

have not changed, as shown in step 410. A MS reporting a drop in received signal level or quality metric may well trigger a toggle back to original BA list, as shown in step 412-400.

It is within the contemplation of the invention that receiving transmissions from neighbouring serving communication units is not the only approach to obtain information useful to a frequency planning operation. Although more complex in assessing the meaning of such information within the OMC 146, useful information can be gleaned from neighbouring MS transmissions, whether within the same cell or from a neighbouring cell. As such, the modified BA list may include second communication resource information such as a frequency and time slot of a neighbouring MS.

It is also within the contemplation of the invention that the threshold that is used to switch between a first scanning mode of operation using the original BA list, and a second scanning mode of operation using a modified BA list, can be pre-defined or dynamically generated. It is envisaged that dynamically changing the threshold value will be particularly useful when linked into traffic load within any particular cell or the system as a whole, the time of day, etc.

It is also within the contemplation of the invention that, if the mobile station is in an idle mode, a serving communication unit may transmit a paging signal to MS 112, where the paging signal includes the modified list

of communication resources to said mobile station. In such a manner, MS 112 receives the paging signal during the course of a normal communication access process, minimising the impact on the communication system's signalling resource.

It will be understood that the communication system, communication unit, and method for resource planning in a communication system described above provides (at least) the following advantages:

(i) low strength external broadcast channels (BCCHs) can be scanned, and the signal transmission information obtained therefrom by MSs better utilised;

(ii) more optimal use of the BA list can be made;

(iii) the system is better able to adapt to variations in indoor traffic load and mobility; and

(iv) reliance on external network data is reduced.

Thus a communication system, a communication unit, and a method for resource planning in a communication system have been provided wherein the aforementioned disadvantages associated with prior art arrangements have been substantially alleviated.

Claims

1. A method of scanning adjacent cells in a wireless communication system comprising a plurality of serving communication units providing communication to a plurality of mobile stations within their respective geographic regions, the method comprising the steps of:

scanning signal transmissions from a first list of communication resources, by at least one mobile station of the plurality of mobile stations;

performing at least one signal quality measurement on said received signal transmissions;

reporting said at least one signal quality measurement to a serving communication unit;

the method characterised by the steps of:

determining whether a subset of said signal quality measurements exceed a threshold; and

including at least one second communication resource with a subset of the first list of communication resources to form a modified list of communication resources to be scanned by the mobile station, if said threshold is exceeded.

2. The method of scanning adjacent cells according to claim 1, wherein the first list of communication resources is a list of potential handover candidates.

3. The method of scanning adjacent cells according to claim 1 or claim 2, wherein the modified list of communication resources is a list of communication

resources allocated in an automatic frequency planning operation.

4. The method of scanning adjacent cells according to claim 3, the method further characterised by the steps of:

performing said signal quality measurements on said modified list of communication resources; and

reporting said signal quality measurements to assist in said automatic frequency planning operation.

5. The method of scanning adjacent cells according to any preceding claim, the method further characterised by the steps of:

generating a first list or modified list of communication resources at the serving communication unit; and

transmitting said first list or modified list of communication resources to said mobile station, wherein said first list or modified list of communication resources indicates the manner of receiving signals at the mobile station.

6. The method of scanning adjacent cells according to claim 5, wherein the first list or modified list of communication resources includes at least one of the following with respect to the first mobile station: frequency of a communication resource, time slot of a communication resource, spreading code of a communication resource, direction of arrival of a received signal, timing of a received signal, received signal strength.

7. The method of scanning adjacent cells according to any of the preceding claims, the method further characterised by the step of:

toggling, by the mobile station, between scanning the first list of communication resources and scanning the modified list of communication resources.

8. The method of scanning adjacent cells according to any preceding claim, wherein the reporting step includes:

reporting said signal quality measurements after each signal quality measurement is processed; or

reporting said signal quality measurements in partial grouping or whole grouping and transmitting said signal quality measurements to said serving communication unit at the end of processing said grouping.

9. The method of scanning adjacent cells according to any preceding claim, the method further characterised by the step of:

returning to scanning the first list of communication resources, by the mobile station, if a signal quality measurement of the at least one of the subset of the first list of communication resources or the at least one communication resource of the second list falls below said threshold.

10. The method of scanning adjacent cells according to any preceding claim, wherein the at least one communication resource of the second list is selected

because the signal transmission of said resource falls below said threshold.

11. The method of scanning adjacent cells according to claim 10, wherein if the mobile station is in an idle mode, the method is further characterised by the steps of:

transmitting, by said serving communication unit, a paging signal including the modified list of communication resources to said mobile station;

receiving said paging signal at said mobile station; and

12. The method of scanning adjacent cells according to any preceding claim, wherein said reporting step includes reporting said signal quality measurements to the serving communication unit to provide information on traffic loading on adjacent cell(s).

13. The method of scanning adjacent cells according to any preceding claim, wherein said determining step includes determining a minimum subset of said signal quality measurements of said first communication resource in order to maximise the number of said scanned communication resources from said second list.

14. The method of scanning adjacent cells according to any preceding claim, wherein the step of scanning includes scanning signal transmissions from a plurality of adjacent serving communication units or mobile

stations being served by said adjacent serving communication units.

15. A communication system adapted to perform any of the method steps of claims 1 to 14.

16. A communication unit adapted to perform any of the method steps of claims 1 to 14.

17. A storage medium storing processor-implementable instructions for controlling a processor to carry out the method steps of any of claims 1 to 14.

18. A wireless communication system comprising a plurality of serving communication units communicating with a plurality of mobile stations within respective geographic regions, at least one mobile station including:

scanning means for receiving signal transmissions from a from a plurality of communication units identified on a first list of communication resources;

signal quality measurement means operably coupled to said scanning means to determine a signal quality of said received signal transmissions; and

a transmitter operably coupled to said signal quality measurement means to report said signal quality measurements to a serving communication unit;

the communication system characterised by:

a processor determining whether a subset of said signal quality measurements from a first mobile station exceed a threshold; and

a transmitter in the serving communication unit transmitting instructions to said first mobile station to include at least one second communication resource to be scanned by the mobile station, from a second list of communication resources, if said threshold is exceeded.

19. The communication system according to claim 18, further comprising a storage element, operably coupled to the processor, wherein the storage element stores the first list of communication resources including a list of

potential handover candidates of the first mobile station.

20. The communication system according to claim 18 or claim 19, further comprising a storage element, operably coupled to the processor, wherein the storage element stores the modified list of communication resources including a list of communication resources allocated in an automatic frequency planning operation.

21. The communication system according to any of claims 18 to 20, wherein the list of communication resources includes at least one of the following scanning details: frequency, time slot(s), spreading code(s), direction of arrival of the received signal, timing of the received signal, received signal strength.

22. The communication system according to any of claims 18 to 21, wherein said signal quality measurements provide information on traffic loading on said adjacent cell.

23. The communication system according to any of claims 18 to 22, wherein the mobile station is adapted to scan signal transmissions from a plurality of adjacent serving communication units or mobile stations being served by said adjacent serving communication units.

24. The communication system according to any of preceding claims 18 to 23, the communication system further characterised by the processor generating a first

or modified list in the communication system architecture, the communication system further characterised by a transmitter, operably coupled to said processor, transmitting said first or modified list to said mobile station, wherein said first or modified list indicates the manner of receiving signals at the mobile station.

25. The communication system according to claim 24, wherein the first or modified list includes at least one of the following with respect to the first mobile station: spreading code, direction of arrival of the received signal, timing of the received signal, received signal strength.

26. The communication system according to any one of claims 18 to 25, wherein the communication resource list is generated and/or maintained in at least one of the following in the communication system network: MSC, BSC, OMC.

27. A communication unit adapted to operate in the communication system of any one of claims 18 to 26.

28. A communication system substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 1 or FIG. 2 of the accompanying drawings.

29. A communication unit substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 3 of the accompanying drawings.

30. A method of scanning adjacent cells in a wireless communication system substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 4 of the accompanying drawings.

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Claims searched:	1 to 30	**Date of search:**	2 February 2002

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H4L (LRPMA, LRPMX, LRRMS, LFMA, LFMX)

Int Cl (Ed.7): H04B 17/00, H04Q 7/32, 7/34, 7/36

Other: Online: WPI, JAPIO, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2344972 A (ERICSSON) see whole document	-
A	GB 2327014 A (ERICSSON) see whole document	-

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